What is stochiometric analysis and what laws apply?

* It deals with weights (or masses) of materials and the energy liberated in chemical (combustion)

* The chemical reactions are usually idealised

* Assumes the fuel is completely mixed with air (which cannot be true for solids, especially for lumps of coal until they decompose to finer grains)

* The products of combustion are not complex, but nearly always simply CO2 and H2O

* Conversion of mass applies

* **The first law of thermodynamics** applies...energy is conserved

* All substances combine in accordance with very simple and definite volume or weight or mass relationships

* The perfect gas law applies, to gases involved : PV = mRT

*** Avogadro law applies:** Equal volumes of perfect gases at the same temperature and pressure have the same number of molecules.

* It follows that there must be a fixed volume for gases' molecules. this molar volume, the volume of one of the fundamental molecular collections or moles of gas, a kmol in SI Units, is:

22.41 m3 /kmol for any perfect gas at 1 atm pressure and 0 C or

22.46 m3/kmol at 1 atm pressure and 25 C

*** Dalton's Law of partial pressure applies to gases:**

The total pressure of a mixture of gases = the sum of partial pressure of each gas, which would be exerted by each gas if it alone occupied the same volume as the mixture

*** Amagat's Law applies to gases:**

The total volume occupied by a mixture of gases = the sum of the volumes which would be occupied by each constituent when at the same temperature and pressure as the mixture

*** Mass conservation**

Every atom must be accounted for. There is no change of mass or weight during a combustion process e.g., if an engine operates on an Air/Fuel (A/F) ratio of 15/1 (by weight) then

1kg fuel + 15 kg air produces 16 kg of exhaust (plus chemical energy released as 'heat', some of which is converted to useful 'work')

or

2H2 (ie., 2 molecules of hydrogen) + O2 (ie.,1molecule of oxygen) produces 2 H2O (ie., 2 molecules of water vapor). The numbers of atoms must balance in this chemical equation.

*** Law of combining weights (or masses)**

Elements and compounds combine in simple consant proportions to form definite compounds. These proportions by mass or weight are always exactly ratios of the molecular weights of the constituents. Therefore we always state chemical reactions in terms of the number of molecular weights or moles or kmols of the elements or compounds.

* A molecular mass in SI Units or kilomole abbreviated as kmol is the mass of a substance whose mass in kg is numerically equal to its molecular weight MW.

*** Molecular weights (or masses)** are always drawn from the periodic table atomic weights and based on the AW of oxygen which is 16.00 (though even that is now considered to be 15.9995). Therefore the kmol is the amount of substance containing as many elemental entities as there are atoms in 32 kg (actually 31.999 kg) of oxygen, or atoms in 12 kg (actually 12.011 kg) of carbon 12.